

WHAT IS CLAIMED IS:

1. An image processing apparatus for performing error  
diffusion processing on multivalued image data having  
plural density components and outputting the result of  
5 said error diffusion processing, comprising:

first determination means for, upon execution of  
said error diffusion processing on a first density  
component among said plural density components,  
determining a threshold value used in said error  
10 diffusion processing based on a density value of a  
second density component;

first error diffusion execution means for  
executing said error diffusion processing on said first  
density component based on the threshold value  
15 determined by said first determination means;

first output means for outputting the result of  
execution of said error diffusion processing by said  
first error diffusion execution means;

second determination means for, upon execution of  
20 said error diffusion processing on said second density  
component among said plural density components,  
determining a threshold value used in said error  
diffusion processing based on a density value of said  
first density component;

25 second error diffusion execution means for  
performing said error diffusion processing on said  
second density component based on the threshold value

determined by said second determination means; and

second output means for outputting the result of execution of said error diffusion processing by said second error diffusion execution means.

5

2. The apparatus according to claim 1, wherein said first and second determination means use a table showing a relation between density and threshold values, for determining the threshold values.

10

3. The apparatus according to claim 1, wherein said first and second determination means respectively determine plural threshold values.

15

4. The apparatus according to claim 3, wherein said first and second determination means respectively use plural tables for determining said plural threshold values.

20

5. The apparatus according to claim 1, further comprising:

third determination means for, upon execution of said error diffusion processing on a third density component among said plural density components,  
25 determining a threshold value used in said error diffusion processing based on the sum of the density values of said first and second density components;

third error diffusion execution means for  
executing said error diffusion processing on said third  
density component based on the threshold value  
determined by said third determination means; and

5        third output means for outputting the result of  
execution of said error diffusion processing by said  
third error diffusion execution means.

6. The apparatus according to claim 5, wherein, in a  
10       case where said error diffusion processing is performed  
on said first to third density components,

             said first determination means determines the  
threshold value used in said error diffusion processing  
on said first density component, based on the sum of the  
15       density value of said second density component and a  
density value of said third density component,

             and said second determination means determines the  
threshold value used in said error diffusion processing  
on said second density component, based on the sum of  
20       the density value of said first density component and  
the density value of said third density component.

7. The apparatus according to claim 1, wherein said  
plural density components are a yellow component, a  
25       magenta component, a cyan component and a black  
component,

             and said first density component is the cyan

component, said second density component is the magenta component, and said third density component is the black component.

5 8. The apparatus according to claim 5, further comprising image formation means for inputting the results of execution of said error diffusion processing outputted from said first to third output means and performing image formation.

10 9. The apparatus according to claim 8, wherein said image formation means is an ink-jet printer.

15 10. The apparatus according to claim 9, wherein said ink-jet printer has an ink-jet printhead that discharges ink by utilizing thermal energy,

and wherein said ink-jet printhead has electrothermal transducers for generating the thermal energy to be supplied to the ink.

20 11. An image processing method for performing error diffusion processing on multivalued image data having plural density components and outputting the result of said error diffusion processing, comprising:

25 a first determination step of, upon execution of said error diffusion processing on a first density component among said plural density components,

determining a threshold value used in said error diffusion processing based on a density value of a second density component;

5 a first error diffusion execution step of executing said error diffusion processing on said first density component based on the threshold value determined at said first determination step;

10 a first output step of outputting the result of execution of said error diffusion processing at said first error diffusion execution step;

15 a second determination step of, upon execution of said error diffusion processing on said second density component among said plural density components, determining a threshold value used in said error diffusion processing based on a density value of said first density component;

20 a second error diffusion execution step of performing said error diffusion processing on said second density component based on the threshold value determined at said second determination step; and

a second output step of outputting the result of execution of said error diffusion processing at said second error diffusion execution step.

25 12. The method according to claim 11, wherein at said first and second determination steps, a table showing a relation between density and threshold values is used

for determining the threshold values.

13. The method according to claim 11, wherein at said first and second determination steps plural threshold values are respectively determined.

14. The method according to claim 13, wherein at said first and second determination steps, plural tables are respectively used for determining said plural threshold values.

15. The method according to claim 11, further comprising:

a third determination step of, upon execution of said error diffusion processing on a third density component among said plural density components, determining a threshold value used in said error diffusion processing based on the sum of the density values of said first and second density components;

a third error diffusion execution step of executing said error diffusion processing on said third density component based on the threshold value determined at said third determination step; and

a third output step of outputting the result of execution of said error diffusion processing at said third error diffusion execution step.

16. The method according to claim 11, wherein, in a case where said error diffusion processing is performed on said first to third density components,

at said first determination step, the threshold  
5 value used in said error diffusion processing on said first density component is determined, based on the sum of the density value of said second density component and a density value of said third density component,

and at said second determination step, the  
10 threshold value used in said error diffusion processing on said second density component is determined, based on the sum of the density value of said first density component and the density value of said third density component.

15  
17. A computer readable memory for storing a program for executing the image processing method according to any one of claims 11 to 16.

20 18. An image processing apparatus for performing error diffusion processing on multivalued image data having plural density components and outputting a result of said error diffusion processing, comprising:

calculation means for calculating a sum and  
25 difference between density values of a first density component and a second density component among said plural density components;

M-ary conversion means for converting a value of the sum into M-ary code by using a first function based on the sum;

5 N-ary conversion means for converting a value of the difference into N-ary code by using a second function based on the difference; and

execution means for executing multivalue error diffusion processing respectively on said first and second density components, based on the result of  
10 conversion by said M-ary conversion means and the result of conversion by said N-ary conversion means.

19. The apparatus according to claim 18, wherein M and N are respectively a positive integer equal to or greater  
15 than 3.

20. The apparatus according to claim 18, wherein said first function used in said M-ary conversion means is represented in a first table showing a relation between  
20 the value of the sum and an M-ary code,

and wherein said second function used in said N-ary conversion means is represented in a second table showing a relation between the value of the difference and an N-ary code.

25

21. The apparatus according to claim 18, wherein said multivalue error diffusion processing is executed by



said execution means by using a two-dimensional table with the result of the conversion by said M-ary conversion means and the result of the conversion by said N-ary conversion means as functions.

5

22. The apparatus according to claim 21, wherein said two-dimensional table is a common table for said first and second density components.

10 23. The apparatus according to claim 21, wherein said two-dimensional table is prepared respectively for said first and second density components.

24. The apparatus according to claim 18, wherein said  
15 plural density components are a yellow component, a magenta component, a cyan component and a black component,

and wherein said first density component is the cyan component, and said second density component is the  
20 magenta component.

25. The apparatus according to claim 18, further comprising image formation means for inputting the result of execution of said error diffusion processing  
25 and performing image formation.

26. The apparatus according to claim 25, wherein said

image formation means is an ink-jet printer.

27. The apparatus according to claim 26, wherein said  
ink-jet printer has an ink-jet printhead that discharges  
5 ink by utilizing thermal energy,

and wherein said ink-jet printhead has  
electrothermal transducers for generating the thermal  
energy to be supplied to the ink.

10 28. An image processing method for performing error  
diffusion processing on multivalued image data having  
plural density components and outputting a result of  
said error diffusion processing, comprising:

a calculation step of calculating a sum and  
15 difference between density values of a first density  
component and a second density component among said  
plural density components;

an M-ary conversion step of converting a value of  
the sum into M-ary code by using a first function based  
20 on the sum;

an N-ary conversion step of converting a value of  
the difference into N-ary code by using a second  
function based on the difference; and

an execution step of executing multivalue error  
25 diffusion processing respectively on said first and  
second density components, based on the result of  
conversion at said M-ary conversion step and the result

of conversion at said N-ary conversion step.

29. The method according to claim 28, wherein M and N  
are respectively a positive integer equal to or greater  
5 than 3.

30. The method according to claim 28, wherein said first  
function used at said M-ary conversion step is  
represented in a first table showing a relation between  
10 the sum value and an M-ary code,

and wherein said second function used at said N-  
ary conversion step is represented in a second table  
showing a relation between the difference value and an  
N-ary code.

15  
31. The method according to claim 28, wherein said  
multivalue error diffusion processing is executed at  
said execution step by using a two-dimensional table  
with the result of the conversion at said M-ary  
20 conversion step and the result of the conversion at said  
N-ary conversion step as functions.

32. The method according to claim 28, wherein said  
plural density components are a yellow component, a  
25 magenta component, a cyan component and a black  
component,

and wherein said first density component is the

cyan component, and said second density component is the magenta component.

33. A computer readable memory for storing a program for  
5 executing the image processing method according to any one of claims 28 to 32.

34. An image processing apparatus for performing error  
diffusion processing on multivalued image data having  
10 plural density components and outputting a result of said error diffusion processing, comprising:

analysis means for examining density values of a first density component and a second density component among said plural density components; and

15 control means for exclusively or independently outputting the result of said error diffusion processing on said first density component and that of said error diffusion processing on said second density component, in accordance with a result of analysis by said analysis  
20 means,

wherein if at least one of said first and second density components has an intermediate density value, said control means independently outputs the results of said error diffusion processing, while if said first and  
25 second density components do not have an intermediate density value, exclusively outputs the results of said error diffusion processing.

35. The apparatus according to claim 34, wherein said analysis means includes:

first comparison means for comparing a sum of the  
5 density values of said first and second density  
components among said plural density components with a  
predetermined threshold value; and

second comparison means for comparing the density  
value of said first density component and the density  
10 value of said second density component with each other,  
wherein said control means performs printing by  
said error diffusion processing based on said first  
density component or said second density component,  
based on results of comparison by said first and second  
15 comparison means.

36. The apparatus according to claim 35, further  
comprising third comparison means for comparing the  
density value of said first density component with said  
20 predetermined threshold value,

wherein said control means further determines  
whether or not printing by said error diffusion  
processing is to be performed not only based on said  
first density component, but also based on the result of  
25 comparison by said third comparison means.

37. The apparatus according to claim 35, further

comprising fourth comparison means for comparing the density value of said second density component with said predetermined threshold value,

wherein said control means further determines  
5 whether or not printing by said error diffusion processing is to be performed not only based on said second density component, but also based on the result of comparison by said fourth comparison means.

10 38. The apparatus according to claim 34, wherein said plural density components are a yellow component, a magenta component, a cyan component and a black component,

and wherein said first density component is the  
15 cyan component, and said second density component is the magenta component.

39. The apparatus according to claim 34, wherein said plural density components of said multivalued image data  
20 are respectively binarized by said error diffusion processing.

40. The apparatus according to claim 34, wherein said plural density components of said multivalued image data  
25 are respectively converted by said error diffusion processing into N-ary codes.

41. The apparatus according to claim 40, wherein said N is a positive integer equal to or greater than 3.

42. The apparatus according to claim 40, further  
5 comprising a table showing a relation between a density value and an N-ary code output value, for N-ary conversion.

43. The apparatus according to claim 42, wherein said  
10 table is a common table for said first and second density components.

44. The apparatus according to claim 42, wherein said  
15 table is prepared respectively for said first and second density components.

45. The apparatus according to claim 34, further  
comprising image formation means for inputting a result  
of execution of said error diffusion processing and  
20 performing image formation.

46. The apparatus according to claim 45, wherein said  
image formation means is an ink-jet printer.

25 47. The apparatus according to claim 46, wherein said ink-jet printer has an ink-jet printhead that discharges ink by utilizing thermal energy,

and wherein said ink-jet printhead has electrothermal transducers for generating the thermal energy to be supplied to the ink.

- 5 48. The apparatus according to claim 34, wherein said intermediate density is higher than an approximately half level of a maximum density level.

- 10 49. An image processing method for performing error diffusion processing on multivalued image data having plural density components and outputting a result of said error diffusion processing, comprising:

- an analysis step of examining density values of a first density component and a second density component  
15 among said plural density components; and

- a control step of exclusively or independently outputting the result of said error diffusion processing on said first density component and that of said error diffusion processing on said second density component,  
20 in accordance with a result of analysis at said analysis step,

- wherein at said control step, if at least one of said first and second density components has an intermediate density value, the results of said error  
25 diffusion processing are independently outputted, while if said first and second density components do not have an intermediate density value, the results of said error



diffusion processing are exclusively outputted.

50. The method according to claim 49 wherein said analysis step includes:

5       a first comparison step of comparing a sum of the density values of said first and second density components among said plural density components with a predetermined threshold value; and

10       a second comparison step of comparing the density value of said first density component and the density value of said second density component with each other,

15       wherein at said control step, printing is performed by said error diffusion processing based on said first density component or said second density component, based on results of comparison at said first and second comparison steps.

51. The method according to claim 50, further comprising a third comparison step of comparing the density value  
20 of said first density component with said predetermined threshold value,

      wherein at said control step, it is further determined whether or not printing by said error diffusion processing is to be performed not only based  
25 on said first density component, but also based on result of comparison at said third comparison step.

52. The apparatus according to claim 50, further comprising a fourth comparison step of comparing the density value of said second density component with said predetermined threshold value,

5        wherein at said control step, it is further determined whether or not printing by said error diffusion processing is to be performed not only based on said second density component, but also based on result of comparison at said fourth comparison step.

10

53. The method according to claim 49, wherein said plural density components are a yellow component, a magenta component, a cyan component and a black component,

15        and wherein said first density component is the cyan component, and said second density component is the magenta component.

54. The method according to claim 49, wherein said  
20 plural density components of said multivalued image data are respectively binarized by said error diffusion processing.

55. The method according to claim 49, wherein said  
25 plural density components of said multivalued image data are respectively converted by said error diffusion processing into N-ary codes.

56. The method according to claim 55, wherein said N is a positive integer equal to or greater than 3.

5 57. The method according to claim 49, wherein said intermediate density is higher than an approximately half level of a maximum density level.

10 58. A computer readable memory for storing a program for executing the image processing method according to any one of claims 49 to 57.